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THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE ETHNOLOGICAL ANALYSIS OF CULTURE[1]

DURING the last few years great additions have been made to our store of the facts of anthropology—we have learned much about different peoples scattered over the earth and we understand better how they act and think. At the same time we have, I hope, made a very decided advance in our knowledge of the methods by means of which these facts are to be collected, so that they may rank in clearness and trustworthiness with the facts of other sciences. When, however, we turn to the theoretical side of our subject, it is difficult to see any corresponding advance. The main problems of the history of human society are little, if at all, nearer their solution, and there are even matters which a few years ago were regarded as settled which are today as uncertain as ever. The reason for this is not far to seek; it is that we have no general agreement about the fundamental principles upon which the theoretical work of our science is to be conducted.

In surveying the different schools of thought which guide theoretical work on human culture, a very striking fact at once presents itself. In other and more advanced sciences the guiding principles of the workers of different nations are the same. The zoologists or botanists of France, Germany, America, our own and other countries, are on common ground. They have in general the same principles and the same methods, and the work of all

[1] Address of the president to the Anthropological Section. Portsmouth, 1911.

falls into a common scheme. Unfortunately this is not so in anthropology. At the present time there is so great a degree of divergence between the methods of work of the leading schools of different countries that any common scheme is impossible, and the members of one school wholly distrust the work of others whose conclusions they believe to be founded on a radically unsound basis.

I propose to consider in this address one of the most striking of these divergences, but, before doing so, I will put as briefly as possible what seem to me to be the chief characters of the leading schools of different countries. To begin with that dominant among ourselves. The theoretical anthropology of this country is inspired primarily by the idea of evolution founded on a psychology common to mankind as a whole, and further, a psychology differing in no way from that of civilized man. The efforts of British anthropologists are devoted to tracing out the evolution of custom and institution. Where similarities are found in different parts of the world it is assumed, almost as an axiom, that they are due to independent origin and development, and this in its turn is ascribed to the fundamental similarity of the workings of the human mind all over the world, so that, given similar conditions, similar customs and institutions will come into existence and develop on the same lines.

In France we find that, as among ourselves, the chief interest is in evolution, and the difference is in the principles upon which this evolution is to be studied. It is to the psychological basis of the work of British anthropologists that objection is chiefly made. It is held that the psychology of the individual can not be used as a guide to the collective actions of men in early stages of social evolution, still less the psychology of the individual whose social ideas have been molded by the long ages of evolution which have made our own society what it is. It is urged that the study of sociology requires the application of principles and methods of investigation peculiar to itself.[2]

About America it is less easy to speak, because it is unusual in that country to deal to any great extent with general theoretical problems. The anthropologists of America are so fully engaged in the attempt to record what is left of the ancient cultures of their own country that they devote little attention to those general questions to which we, more unfortunately situated with no ancient culture at our doors, devote so much attention. There seems, however, to be a distinct movement in progress in America which puts the evolutionary point of view on one side and is inclined to study social problems from the purely psychological point of view, the psychological standpoint, however, approaching that of the British school more nearly than that of the French.[3]

It is when we come to Germany that we find the most fundamental difference in standpoint and method. It is true that in Adolf Bastian Germany produced one who was thoroughly imbued with the evolutionary standpoint, and the *Elementargedanke* of that worker forms a most convenient expression for the psychological means whereby evolution is supposed to have

[2] I refer here especially to the work of the "sociological" school of Durkheim and his followers. For an account of their principles and methods see *L'Année sociologique*, which began to appear in 1898; Durkheim, "Les Règles de la Méthode Sociologique," Paris; and Lévy-Bruhl, "Les fonctions mentales dans les sociétés inférieures," Paris, 1910.

[3] See especially A. L. Kroeber, "Classificatory Systems of Relationship," *Journ. Roy. Anthr. Inst.*, 1909, XXXIX., 77; and Goldenweiser, "Totemism: An Analytical Study," *Journ. Amer. Folk-Lore*, 1910, XXIII.

proceeded. In recent years, however, there has been a very decided movement opposed to Bastian and the whole evolutionary school. In some cases this has formed part of that general revolt not merely against Darwinism which is so prominent in Germany, but it seems even against the whole idea of evolution. In other cases the objection is less fundamental, and has been not so much to the idea of evolution itself as to the lines upon which it has been customary to endeavor to study this evolution.

This movement, which by those who follow it is called the geographical movement, but which, I think, may be more fitly styled "ethnological," was originated by Ratzel, who was first led definitely in this direction by a study of the armor made of rods or plates or laths which is found in North America, northern Asia, including Japan, and in a less developed form in some of the islands of the Pacific Ocean.[4] Ratzel believed that the resemblances he found could only be explained by direct transmission from one people to another and was led by further study to become an untiring opponent of the *Elementargedanke* of Bastian and of the idea of independent evolution based on a community of thought.[5] He has even suggested that the idea of independent origin is the anthropological equivalent of the spontaneous generation of the biologist and that anthropology is now going through a phase of development from which biology has long emerged.

The movement initiated by Ratzel has made great progress, especially through the work of Graebner[6] and of P. W. Schmidt.[7] It has resulted in an important series of works in which the whole field of anthropological research is approached in a manner wholly different from that customary in this country.[8] I must content myself with one example to illustrate the difference of standpoint which separates the two schools. Few subjects have attracted more interest in this and other countries than the study of primitive decoration. In the decorative art of all lands there are found transitions from designs representing the human form or those of animals and plants to patterns of a purely geometrical nature. In this country it has been held, I think I may say universally, that in these transitions we have evidence for an evolutionary process which in all parts of the world has led mankind to what may be called the degradation and conventionalization of human, animal or plant designs so that in course of time they become mere geometrical forms.

To the modern German school, on the other hand, these transitions are examples of the blending of two cultures, one pos-

[4] *Sitzber. d. Akad. d. Wiss. München,* Hist. Cl., 1886, p. 181.

[5] See especially *Anthropogeographie,* 1891, Th. II., 705, and "Die geographische Methode in der Ethnographie," *Geograph. Zeitsch.,* 1897, III., 268.

[6] See especially Graebner, "Methode der Ethnologie," Heidelberg, 1911, and "Die melanesische Bogenkultur und ihre Verwandten," *Anthropos,* 1909, IV., 726. The annual *Ethnologica,* edited by W. Foy, is devoted to the illustration of this school of thought.

[7] See especially "L'origine de l'Idée de Dieu," *Anthropos,* III.–V., 1908–10, and "Grundlinien einer Vergleichung der Religion u. Mythologie der austronesischen Völker," *Denksch. d. Akad. d. Wiss. Wien,* Phil.-hist. Kl., 1910, LIII. Schmidt differs from Graebner in limiting the application of the ethnological method to regions with general affinities of culture. Otherwise he remains an adherent of the doctrine of independent origin. (See "Panbabylonismus und ethnologischer Elementargedanke," *Mitt. d. anthrop. Gesellsch. in Wien,* 1908, XXXVIII., 73.)

[8] It must not be understood from this account that all German anthropologists are adherents of the ethnological school. There are still those who follow the doctrines of Bastian, which have undergone an interesting modification through the adoption of the biological principle of convergence.

sessing the practise of decorating their objects with human, animal or plant designs, while the art of the other is based on the use of geometrical forms. The transitions which have been taken to be evidence of independent processes of evolution based on psychological tendencies common to mankind are by the modern German school ascribed to the mixture of cultures and of peoples. Further, similar patterns, even one so simple as the spiral, when found in widely separated regions of the earth, are held to have been due to the influence of one and the same culture.

I have chosen this example because it illustrates the immense divergence in thought and method between the two schools, but the difference runs through the whole range of the subject. In every case where British anthropologists see evolution, either in the forms of material objects or in social and religious institutions, the modern German school sees only the evidence of mixture of cultures, either with or without an accompanying mixture of the races to which these cultures belonged.

It will, I think, be evident that this difference of attitude of British and German workers is one of fundamental and vital importance. When we find the chief workers of two nations thus approaching their subject from two radically different, and it would seem incompatible, standpoints, it is evident that there must be something very wrong, and it has seemed to me that I can not better use the opportunity given to me by the present occasion than in devoting my address to this subject.

The situation is one which has an especial interest for me in that I have been led quite independently to much the same general position as that of the German school by the results of my own work in Oceania with the Percy Sladen Trust Expedition. With no knowledge of the work of this school I was led by my facts to see how much, in the past, I had myself ignored considerations arising from racial mixture and the blending of cultures, and it will perhaps interest you if I sketch briefly the history of my own conversion.

Much of my time in Oceania was devoted to survey work, in which I collected especially the systems of relationship of every place I visited, together with such other facts concerning social organization as I was able to gather. I began my theoretical study by a comparison of the various forms of these systems of relationship, disregarding at first the linguistic nature of the terms. From the study of these systems I was able to demonstrate the existence, either in the present or the past, of a number of extraordinary and anomalous forms of marriage, such as marriage with the daughter's daughter and with the wife of the father's father,[9] all of which become explicable if there once existed widely throughout Melanesia a state which is known as the dual organization of society with matrilineal descent accompanied by a condition of dominance of the old men which enabled them to monopolize all the young women of the community. Taking this as my starting-point, I was then able to trace out a consistent and definite scheme of the history of marriage in Melanesia from a condition in which persons normally and naturally married certain relatives to one in which wives are purchased with whom no relationship whatever can be traced, and I was able to fit many other features of the social structure of Melanesia into this scheme. So far my work was of a purely evolutionary character, and only served to strengthen me in my previous standpoint.

I then turned my attention to the linguistic side of the systems of relationship,

[9] These terms are used in the classificatory sense.

and a study of the terms themselves showed that these fell into two main classes: one class generally diffused throughout Oceania, while the terms of the other class differed very considerably in different cultural regions. Further, it became clear that the terms of the first class denoted relationships which my comparative study of the forms of the systems had shown to have suffered change, while the terms which varied greatly in different parts of Oceania denoted relationships, such as those of the mother and mother's brother, which there was no reason to believe had suffered any great change in status. From these facts I inferred that at the time of the most primitive stage of Melanesian society of which I had evidence, there had been great linguistic diversity which had been transformed into the relative uniformity now found in Melanesia by the incoming of a people from without, through whose influence the change I had traced had taken place, and from whose language the generally diffused terms of relationship had been borrowed. It was through the combined study of social forms and of language that I was led to see that the change I had traced was not a spontaneous evolution, but one which had taken place under the influence of the blending of peoples. The combined morphological and linguistic study of systems of relationship had led me to recognize that a definite course of social development had taken place in an aboriginal society under the influence of an immigrant people.

I turned next to a Melanesian institution, that of secret societies, concerning which I had been able to gather much new material, and it soon became probable that these societies belonged properly neither to the aboriginal culture nor to that of the immigrants, but had arisen as the result of the interaction of the two; that, in fact, these secret societies had had their source in the need felt by the immigrants for the secret practise of the rites they had brought with them from their former home. A comparison of the ritual of the secret societies with the institutions of other parts of Oceania then made it appear that the main features of the culture of these immigrants had been patrilineal descent, or at any rate definite recognition of the relation between father and child, a cult of the dead, the institution of taboo, and, lastly, certain relations with animals and plants which were probably allied to totemism, if they were not totemism itself in a fully developed form.

Further study made it clear that those I have called the immigrant people, though possessing these features in common, had reached Melanesia at different times and with several decided differences of culture, but that probably there had been two main streams: one which peopled Polynesia and became widely diffused throughout Melanesia, which was characterized by the use of kava; another which came later and penetrated much less widely, which brought with it the practise of chewing betel-mixture. Traces of a third stream, the earliest of all, are probably to be found here and there throughout Melanesia, while still another element is provided by recent Polynesian influence. It became evident that the present condition of Melanesian society has come into being through the blending of an aboriginal population with various peoples from without, and it therefore became necessary to ascertain to which of the cultures possessed by these peoples the present-day customs and institutions of Melanesia belong, always keeping in mind the possibility that some of these institutions may not have belonged to any one of the cultures, but may have arisen as the

result of the interaction of two or more of the blending peoples.

I must be content with this brief sketch of my scheme of the history of Melanesian society, for my object to-day is to point out that if Melanesian society possesses the complexity and the heterogeneous character I have indicated and is the resultant of the mixture of three or four main cultures, it can not be right to take out of the complex any institution or belief and regard it as primitive merely because Melanesian culture on the whole possesses a more or less primitive character. It is probable that some of the immigrants into Melanesia had a relatively advanced culture, possibly even that the institutions and ideas they brought with them had been taken from a culture higher still, and, therefore, when we bring forward any Melanesian institution or belief as an example of primitive thinking or acting, our first duty should be to inquire to which stratum of Melanesian culture it belongs.

To illustrate my meaning I have time for only one example. No concept of Melanesian culture has bulked more largely in recent speculation than that of *mana*, the mysterious virtue to which the magico-religious rites of Melanesia are believed to owe their efficacy. This word now seems on its way to enter the English language as a term for that power or virtue which induces the emotions of awe and wonder, and thus provides a most important element not only in the specific mental states which underlie religion, but also plays much the same part in the early history of magic. In recent speculation the idea of *mana* is coming to be regarded as having been the basis of religious ideas and practises preceding the animism which, following Professor Tylor, we have for long regarded as the earliest form of religion, and *mana* is thus held to be not only the foundation of pre-animistic religion, but also the basis of that primitive element of human culture which can hardly be called either religion or magic, but is the common source from which both have been derived. If I am right in my analysis of Oceanic culture, the Melanesian concept of *mana* is not a suitable basis for these speculations. It is certain that the word *mana* belongs to the culture of the immigrants into Melanesia and not to that of the aborigines. It is, of course, possible that though the word belongs to the immigrant culture, the ideas which it connotes may belong to a more primitive stratum, but this is a pure assumption and one which I believe to be contrary to all probability. At any rate, we can be confident that even if the ideas connoted by the term *mana* belong to or were shared by the primitive stratum of Melanesian society, they must have been largely modified by the influence of the alien, but superior culture from which the word itself has been taken. I believe that the Melanesian evidence can legitimately be used in favor of the view that the power or virtue denoted by *mana* is a fundamental element of religion. The analysis of culture, however, indicates that it is not legitimate to use the Melanesian evidence to support the primitiveness of the concept of *mana*. This evidence certainly does not support the view that the concept of *mana* is more primitive than animism, for the immigrants were already in a very advanced stage of animistic religion, a cult of the dead being certainly one of the most definite of their religious institutions.

Further, I believe that the use of the term *mana* in Melanesia in connection with magic, as a term for that attribute of objects used in magic to which they owe their efficacy, is due to an extension of the original meaning of the term, and that it would only be misleading to use the Melanesian facts as evidence in favor of the

concept of *mana* as underlying primitive magic. Here, again, I do not wish to deny that a concept such as that denoted by *mana* may be a primitive element of magic; all that I wish to point out is that the Melanesian evidence can not properly be used to support this view, for the use of the term in connection with magic in Melanesia is not primitive, but secondary and relatively late.

The point, then, on which I wish to insist is that if cultures are complex, their analysis is a preliminary step which is necessary if speculations concerning the evolution of human society, its beliefs and practises, are to rest on a firm foundation.

I have so far dealt only with Melanesia. It is obvious that the same principle that analysis of culture must precede speculations concerning the evolution of institutions is of wider application, but I have time only to deal, and that very briefly, with one other region.

No part of the world has attracted more attention in recent anthropological speculation than Australia, and at the bottom of these speculations, at any rate in this country, there has usually been the idea, openly expressed or implicitly understood, that in the culture of this region we have a homogeneous example of primitive human society. From the time that I first became acquainted with Australian sociology I have wondered at the complacency with which certain features of Australian social organization have been regarded, and especially the combination of the dual organization and matrimonial classes with what appear to be totemic clans like those of other parts of the world. This coexistence of two different forms of social organization side by side has seemed to me the fundamental problem of Australian society, and I confess that till lately, obsessed as I see now I have been by a crude evolutionary point of view, the condition has seemed an absolute mystery.[10] A comparison, however, of Australia and Melanesia has now led me to see that probably we have in Australia, not merely another example of mixture of cultures, but even another resultant of mixture of the same or closely similar components as those which have peopled Melanesia, viz., a mixture of a people possessing the dual organization and matrilineal descent with one organized in totemic clans, possessing either patrilineal descent, or at any rate clear recognition of the relation between father and child. This is no new view, having been already advanced, though in a different form, by Graebner[11] and P. W. Schmidt.[12] If further research should show Australian society to possess such complexity, it will at once become obvious that here also ethnological analysis must precede any theoretical use of the facts of Australian society in support of evolutionary speculations.

It may be objected that we all recognize the complexity of culture, and indeed in the study of regions such as the Mediterranean, where we possess historical evidence, it is this complexity which forms the chief subject of discussion. Further, where we possess historical evidence, as in the cases of the Hindu and Mohammedan invasions into the Malay Archipelago, all anthropologists are fully alive to the complexities and difficulties introduced thereby

[10] I may note here that Mr. Lang, after having considered this problem from the purely evolutionary standpoint ("Anthropological Essays presented to E. B. Tylor," p. 203), concludes with the words, "We seem lost in a wilderness of difficulties."

[11] *Zeitsch. f. Ethnol.*, 1905, XXXVII., 28, and "Zur australischen Religionsgeschichte," *Globus*, 1909, XCVI., 341.

[12] See especially *Zeitsch. f. Ethnol.*, 1909, XLI., 340.

into the study of culture; but where we have no such historical evidence, the complexity of culture is almost wholly ignored by those who use these cultures in their attempts to demonstrate the origin and course of development of human institutions.

I have now fulfilled the first purpose of this address. I have tried to indicate that evolutionary speculations can have no firm basis unless there has been a preceding analysis of the cultures and civilizations now spread over the earth's surface. Without such analysis it is impossible to say whether an institution or belief possessed by a people who seem simple and primitive may not really be the product of a relatively advanced culture forming but one element of a complexity which at first sight seems simple and homogeneous.

Before proceeding further I should like to guard against a possible misconception. Some of those who are interested in the ethnological analysis of culture regard it not only as the first but as the only task of the anthropology of to-day. I can not too strongly express my disagreement with this view. Because I have insisted on the importance of ethnological analysis, I hope you will not for a moment suppose that I underrate the need for the psychological study of customs and institutions. If the necessity for the ethnological analysis of culture be recognized, this psychological study becomes more complicated and difficult than it has seemed to be in the past, but that makes it none the less essential. Side by side with ethnological analysis there must go the attempt to fathom the modes of thought of different peoples, to understand their ways of regarding and classifying the facts of the universe. It is only by the combination of ethnological and psychological analysis that we shall make any real advance. To-day, however, time will not allow me to say more about this psychological analysis, and I must continue the subject from which I have for a moment turned aside.

Having shown the importance of ethnological analysis, I now propose to consider the process of analysis itself and the principles on which it should and must be based if it in its turn is to have any firm foundation. In the analysis of any culture a difficulty which soon meets the investigator is that he has to determine what is due to mere contact and what is due to intimate intermixture, such intermixture, for instance, as is produced by the permanent blending of one people with another either through warlike invasion or peaceful settlement. The fundamental weakness of most of the attempts hitherto made to analyze existing cultures is that they have had their starting-point in the study of material objects, and the reason for this is obvious. Owing to the fact that material objects can be collected by any one and subjected at leisure to prolonged study by experts, our knowledge of the distribution of material objects and of the technique of their manufacture has very far outrun that of the less material elements. What I wish now to point out is that in distinguishing between the effects of mere contact and the intermixture of peoples, material objects are the least trustworthy of all the constituents of culture. Thus, in Melanesia we have the clearest evidence that material objects and processes can spread by mere contact without any true admixture of peoples and without influence on other features of the culture. While the distribution of material objects is of the utmost importance in suggesting at the outset community of culture, and while it is of equal importance in the final process of determining points of contact and in filling in the details of the mixture of cultures, it is the least satisfactory guide to the actual

blending of peoples which must form the solid foundation of the ethnological analysis of culture. The case for the value of magico-religious institutions is not much stronger. Here, again, in Melanesia there is little doubt that whole cults can pass from one people to another without any real intermixture of peoples. I do not wish to imply that such religious institutions can pass from people to people with the ease of material objects, but to point out that there is evidence that they can and do so pass with very little, if any, admixture of peoples or of the deeper and more fundamental elements of the culture. Much more important is language, and if you will think over the actual conditions when one people either visit or settle among another, this greater importance will be obvious. Let us imagine a party of Melanesians visiting a Polynesian island, staying there for a few weeks and then returning home (and here I am not taking a fictitious occurrence but one which really happens). We can readily understand that the visitors may take with them their betel mixture and thereby introduce the custom of betel-chewing into a new home; we can readily understand that they may introduce an ornament to be worn in the nose and another to be worn on the chest; that tales that they tell will be remembered, and dances they perform will be imitated. A few Melanesian words may pass into the language of the Polynesian island, especially as names for the objects or processes which the strangers have introduced, but it is incredible that the strangers should thus in a short visit produce any extensive change in the vocabulary and still more that they should modify the structure of the language. Such changes can never be the result of mere contact or transient settlement, but must always indicate a far more deeply seated and fundamental process of blending of peoples and cultures.

Few will perhaps hesitate to accept this position, but I expect my next proposition to meet with more scepticism, and yet I believe it to be widely, though not universally, true.[13] This proposition is that the social structure, the framework of society, is still more fundamentally important and still less easily changed except as the result of the intimate blending of peoples, and for that reason furnishes by far the firmest foundation on which to base the process of analysis of culture. I can not hope to establish the truth of this proposition in the course of a brief address, and I propose to draw your attention to one line of evidence only.

At the present moment we have before our eyes an object-lesson in the spread of our own people over the earth's surface, and we are thus able to study how external influence affects different elements of culture. What we find is that mere contact is able to transmit much in the way of material culture. A passing vessel which does not even anchor may be able to transmit iron, while European weapons may be used by people who have never even seen a white man. Again, missionaries introduce the Christian religion among people who can not speak a word of English or any language but their own, or only use such European words as have been found necessary to express ideas or objects connected with the new religion. There is evidence how readily language may be affected, and here again the present day suggests a mechanism by which such a change takes place. English is now becoming the language of the Pacific and other parts of the world, through its use as a *lingua franca,*

[13] There are definite exceptions in Melanesia; places where the social structure has been transformed, though the ancient language persists.

which enables natives who speak different languages to converse not only with Europeans, but with one another, and I believe that this has often been the mechanism in the past; that, for instance, the introduction of what we now call the Melanesian structure of language was due to the fact that the language of the immigrant people who settled in a region of great linguistic diversity came to be used as a *lingua franca,* and thus gradually became the basis of the languages of the whole people.

But now let us turn to social structure. We find in Oceania islands where Europeans have been settled as missionaries or traders perhaps for fifty or a hundred years; we find the people wearing European clothes and European ornaments, using European utensils, and even European weapons when they fight; we find them holding the beliefs and practising the ritual of a European religion; we find them speaking a European language often even among themselves, and yet investigation shows that much of their social structure remains thoroughly native and uninfluenced not only in its general form, but often even in its minute details. The external influence has swept away the whole material culture, so that objects of native origin are manufactured only to sell to tourists; it has substituted a wholly new religion and destroyed every material, if not every moral, vestige of the old; it has caused great modification and degeneration of the old language; and yet it may have left the social structure in the main untouched. And the reasons for this are clear. Most of the essential social structure of a people lies so below the surface, it is so literally the foundation of the whole life of the people that it is not seen; it is not obvious, but can only be reached by patient and laborious exploration. I will give a few specific instances. In several islands of the Pacific, some of which have had European settlers on them for more than a century, a most important position in the community is occupied by the father's sister.[14] If any native of these islands were asked who is the most important person in the determination of his life history, he would answer, "My father's sister," and yet the place of this relative in the social structure has remained absolutely unrecorded, and, I believe, absolutely unknown to the European settlers in these islands. Again, Europeans have settled in Fiji for more than a century, and yet it is only during this summer that I have heard from Mr. A. M. Hocart, who is working there at present, that there is the clearest evidence of what is known as the dual organization of society as a working social institution at the present time. How unobtrusive such a fundamental fact of social structure may be comes home to me in this case very strongly, for it wholly eluded my own observation during a visit three years ago.

Lastly, the most striking example of the permanence of social structure which I have met is in the Hawaiian Islands. There the original native culture is reduced to the merest wreckage. So far as material objects are concerned, the people are like ourselves; the old religion has gone, though there probably still persists some of the ancient magic. The people themselves have so dwindled in number, and the political conditions are so altered, that the social structure has also necessarily been greatly modified, and yet I was able to ascertain that one of its elements, an element which I believe to form the deepest layer of the foundation, the very bedrock of social structure, the system of relationship, is still in use unchanged. I was able to obtain a full account of the system as actually used at the present time, and found it to be exactly the same as that

[14] See *Folk-Lore,* 1910, XXI., 42.

recorded forty years ago by Morgan and Hyde, and I obtained evidence that the system is still deeply interwoven with the intimate mental life of the people.

If, then, social structure has this fundamental and deeply seated character, if it is the least easily changed and only changed as the result either of actual blending of peoples or of the most profound political changes, the obvious inference is that it is with social structure that we must begin the attempt to analyze culture and to ascertain how far community of culture is due to the blending of peoples, how far to transmission through mere contact or transient settlement.

The considerations I have brought forward have, however, in my opinion, an importance still more fundamental. If social institutions have this relatively great degree of permanence, if they are so deeply seated and so closely interwoven with the deepest instincts and sentiments of a people that they can only gradually suffer change, will not the study of this change give us our surest criterion of what is early and what is late in any given culture, and thereby furnish a guide for the analysis of culture? Such criteria of early and late are necessary if we are to arrange the cultural elements reached by our analysis in order of time, and it is very doubtful whether mere geographical distribution itself will ever furnish a sufficient basis for this purpose. I may remind you here that before the importance of the complexity of Melanesian culture had forced itself on my mind, I had already succeeded in tracing out a course for the development of the structure of Melanesian society, and after the complexity of the culture had been established, I did not find it necessary to alter anything of essential importance in this scheme. I suggest, therefore, that while the ethnological analysis of cultures must furnish a necessary preliminary to any general evolutionary speculations, there is one element of culture which has so relatively high a degree of permanence that its course of development may furnish a guide to the order in time of the different elements into which it is possible to analyze a given complex.

If the development of social structure is thus to be taken as a guide to assist the process of analysis, it is evident that there will be involved a logical process of considerable complexity in which there will be the danger of arguing in a circle. If, however, the analysis of culture is to be the primary task of the anthropologist, it is evident that the logical methods of the science will attain a complexity far exceeding those hitherto in vogue. I believe that the only logical process which will in general be found possible will be the formulation of hypothetical working schemes into which the facts can be fitted, and that the test of such schemes will be their capacity to fit in with themselves, or, as we generally express it, "explain" new facts as they come to our knowledge. This is the method of other sciences which deal with conditions as complex as those of human society. In many other sciences these new facts are discovered by experiment. In our science they must be found by exploration, not only of the cultures still existent in living form, but also of the buried cultures of past ages.

And here is the hopeful aspect of our subject. I believe our present store of facts, at any rate on the less material sides of culture, to form but a very small part of that which is yet to be obtained, and will be obtained unless we very wilfully neglect our opportunities. Waiting to be collected there is a vast body of knowledge by means of which to test the truth of schemes of the history of mankind, not only of his migrations and settlements, but of the institu-

tions and objects which have arisen at different stages of this history and developed into various forms throughout the world.

And this brings me to my concluding topic. I have tried to show that any speculations concerning the history of human institutions can only have a sound basis if cultures have first been analyzed into their component elements, but I do not wish for one moment to depreciate the importance of attempts to seek for the origin and early history of human institutions. To me the analysis of culture is merely the means to an end which would have little interest if it did not show us the way to the proper understanding of the history of human institutions. The importance of the facts of ethnology in the study of civilized culture is now generally recognized. You can hardly take up a modern work dealing with any aspect of human thought and activity without finding reference to the customs and institutions of savage or barbarous peoples. It is becoming recognized that a study of these helps us to understand much that is obscure in our own institutions or in those of other great civilizations of the present or the past. Further, there can be no doubt that we are only at the threshold of a new movement in learning which is being opened by this comparative study.

It is a cruel irony that just as the importance of the facts and conclusions of ethnological research is thus becoming recognized, and just as we are beginning to learn sound principles and methods for use both in the field and in the study, the material of our science is vanishing. Not only is the march of our own civilization into the hitherto undisturbed places of the earth more rapid than it has ever been before, but this advance has made more easy the spread of other destroying agencies. In many parts of such a region as Melanesia, it is even now only from the old men that any trustworthy information can be obtained, and it is no exaggeration to say that with the death of every old man there and in many other places there goes, and goes forever, knowledge the disappearance of which the scholars of the future will regret as the scholars of the past regretted such an event as the disappearance of the library of Alexandria. There is no other science which is in quite the same position. The nervous system of an animal, the metabolism of a plant, the condition of the South Pole, for instance, will a hundred, or even a thousand, years hence be essentially what they are to-day, but long before the shorter of those times has passed, most, if not all, of the lower cultures now found on different parts of the earth will have wholly disappeared or have suffered such change that little will be learned from them. Fortunately the need for ethnographical research is now forcing itself on the attention of those who have to deal with savage or barbarous peoples. Statesmen have begun to recognize the practical importance of knowledge of the institutions of those they have to govern, and missionary societies are beginning to see, what every wise missionary has long known, that it is necessary to understand the ideas and customs of those whose lives they are trying to reform. Still, we must not be content with these more or less official movements. There is ample scope, indeed urgent need, for individual effort and for non-official enterprise. It is not all who can go into the field and do the needed work themselves, but there are none who can not in some way help to promote ethnographical research. We have before us one of those critical occasions which must be seized at once if they are to be seized at all: the occasion of a need which to future generations will seem to have been so obvious

that its neglect will be held an enduring reproach to the science of our time.

W. H. R. RIVERS

THE NEW CHESTNUT BARK DISEASE

IN the latter part of the year 1904 Mr. H. W. Merkel discovered in the Bronx Botanical Garden a new and peculiar form of attack on the American wild chestnut tree, *Castanea dentata*. Prior to the finding of the cause of the infection, it had been noticed that this tree seemed to be in an abnormal condition.

A study of the infection was then undertaken and cultures were successfully made. It was determined, after its life history was better understood, that the attack was caused by a fungus, or a plant of fungoid nature, one of the Pyrenomycetes, a larger order of low-type plants, containing some of our most injurious fungi. The fungi in this order are known to attack not only other plants, but insects. Other well-known examples of this order of fungi are black knot of the plum and ergot of rye.

The chestnut blight has been identified by Professor Murrill as one of the genus *Diaporthe* named by him *parasitica,* and botanically described in *Torreya,* Vol. 6, No. 9, for September, 1906. Some doubt has recently been thrown about the genus to which it belongs. Because of its formation of ascospores within well-defined perithecia it is agreed that it rightfully belongs among the Pyrenomycetes. Its peculiar parasitic habit, however, is sufficient to cast some doubt upon the designation of the genus. No other well-known *Diaporthe* is parasitic. They are saprophytes. Because of its economic importance, almost vicious persistency and deadly habits with respect to its host, the wild chestnut, it might well be assigned to a new genus erected within the order. For a new generic name, the idea contained in the Greek Νικρωσις (nikrosis), a slaughtering unto extinction, would not be beside the fact.

The exterior appearance of this fungus first is numerous yellow pustules on the smooth bark of the tree. In the deep cracks of the oldest bark it takes the form of yellow or orange lines. Later the color turns to a much deeper yellow and finally brown of deepening shades. Within the pustules, the perithecia are found closely clustered, sometimes appressed. In outline they are not unlike the long-necked gourd, or a glass water-bottle. The walls of the neck of a perithecium are black, glistening, and, when cut across, have the sheen of anthracite coal. Within the perithecia are the elongated sacs or asci containing the spores, always eight in number, usually arranged in two rows, glassy and somewhat constricted across the short diameter. The largest of the asci will measure about 10×50 microns; the contained winter spores sometimes as much as 5×10 microns. Two forms of spores are found, as in many other fungi. The summer spores are produced in golden yellow threads protruded from the dome of the pustule, usually much twisted, and rarely found over a half inch in length. These summer spores, with dimensions not more than a fifth of those of the winter form, are exceedingly minute. By abrasion, action of rainfall, or other causes, they are scattered about continuously during the growing season.

It has been shown that the summer spores are of a sticky, gelatinous character. They are therefore peculiarly adapted to be carried about on the feet of insects, squirrels, or birds. Much of the heretofore inexplainable isolated spot infection must be attributed to such means of distribution, and less to wind action. But a spore covered with minute dust particles could just as easily be wind sown, as if it were originally of a scarious nature.

Entrance into a new host may be effected through slight wounds in the bark, broken twig ends or through insect tunnels, carried there by the insect itself. It was formerly believed that it entered only by these means. During the survey made along the main line of the Pennsylvania Railroad in the fall of 1910, by the Pennsylvania Department of Forestry, numerous instances were found where it seemed to have enacted through the lenticels of the bark, without insect aid or previous traumatism. It was also believed that the

fungus infects only the cambium of the bark and that the mycelium did not enter the cambium of the wood. During the survey just referred to, one well-defined instance was found where yellow pustules, plump and vigorous, *were growing upon freshly exposed wood.*

In this region the beginning of infection in a large number of cases was at a single point in the crown and in a few brown pustules in the deep cracks at the base of the tree. An exposed root running out horizontally for a foot or more was almost sure to contain pustules, no doubt washed down the stem by the rains, or brought by drip from neighboring trees with infected branches.

The appearance of the bark of a tree after an attack from this fungus is extremely characteristic. The bark will split, the surface within the lesion shows a sulphury-yellow tint, while numerous brown but minute wart-like excrescences will be found upon the unbroken bark surface. In the deep old bark cracks, it takes the appearance of reddish or orange-colored lines. The tendency of the disease is to encircle the branch or trunk. This produces another well-known mark, a depression or apparent sinking of the affected bark. In reality this is caused by the tree rushing nutriment to the spot and depositing it at the edges of the infected area, circulation being cut off within.

Another noteworthy fact respecting the life of this fungus is its great vitality. Unbarked chestnut rails made into fence and apparently well dried for a year or more have been found to contain active fruiting bodies. A pile of fence rails containing bark which was decayed to the point of falling from the wood by its own weight carried the blight in vigorous condition after two years. A specimen contained in a moist cell was found to be producing pustules after thirty-seven months. Just what amount of vitality will be retained by the dried spores and for how long is not definitely known. Certain it is, however, that the life within it is of unusual persistency and must be dealt with from that view point.

Prior to the year 1908 the chestnut bark disease was almost unknown in Pennsylvania. In the latter part of that year and in the early part of 1909, the attention of the Pennsylvania Department of Forestry was directed to its threatened invasion, by Dr. John Mickleborough, of Brooklyn, N. Y. Dr. Mickleborough pointed out the fact that the disease had probably entered the state and would continue its course westward were it not checked; also that it would be desirable to know to what extent it had entered Pennsylvania. Accordingly, the Deputy Commissioner of Forestry was detailed to accompany Dr. Mickleborough on a tour of inspection to determine the limits of the disease. This work was begun in the latter part of March, 1909, and was continued throughout that month and during the month of April, in which time many localities were examined. All of the southeastern counties of the state were inspected. At this time it was found that the main body of the disease was confined to the southeastern corner and that it had not crossed the north branch or the main river Susquehanna, except in the two instances discovered by the U. S. Department of Agriculture. Following this inspection, a report was prepared and printed, illustrated with drawings of the fungus in detail and accompanied by a print made by color photography, showing the appearance of the disease on living bark when developed to its fullest growth. Beside the articles appearing in botanical periodicals and the early reports of the U. S. Department of Agriculture, this report was the first to cover in detail any portion of country and the first report to be issued on the subject by any one of the states. Thus, within a short period, the disease developed from something unknown to a very decided and prominent attack upon one of the important wild trees of the commonwealth, and was rapidly extending itself to the western counties.

Somewhat prior to this time the officials of the Office of Forest Pathology in the U. S. Department of Agriculture were concerning themselves with its appearance in and around the city of Washington. They found it there rather numerously, and immediately applied the heroic remedy of cutting out and destroy-

ing every tree showing the infection. In this way it was possible to eradicate the disease for a distance of forty miles around the city, and to-day that area is believed to be almost if not quite free from infection. In this fact lies great hope, and it has a bearing of much importance upon future efforts to be made by any state for the eradication of the fungus.

As soon as its prevalence was proved in southeastern Pennsylvania, a determined sentiment arose looking to its destruction, or at least to staying its spread in such degree that it might not be communicated into new areas. Probably the worst infected portion of the state of Pennsylvania is that region along the main line of the Pennsylvania Railroad from the city of Philadelphia westward for a distance of fifty miles. The peculiarity of the infection in this region is that it seems to become more virulent the nearer one approaches the railroad, and is scattered in spots at distances therefrom. Whether this fact is sufficiently significant to point to railroad trains as vehicles of distribution, possibly remains to be proved; but it is a fact worthy of careful attention.

Along this portion of the railroad there exists a civic body known as The Main Line Citizens' Association, banded together for the good of the neighborhood. The chestnut tree forms a large proportion of all the wooded areas in this locality and is one of the best park, woodlands and lawn shade trees of natural growth in that region. Realizing that serious trouble has come upon the chestnut trees, this association appointed a committee to inquire into the trouble; and in the spring of 1910 this committee entered into negotiations with the Pennsylvania Department of Forestry for the purpose of making a proper inquiry into the situation. The result of the maturing of their plans was that a corps of inspectors consisting of foresters, students in forestry, and draftsmen, under the direction of the Deputy Commissioner of Forestry, located themselves at Ardmore in the midst of the infected region, and immediately began a detailed survey of the neighborhood hereinabove referred to, for the purpose of determining to what extent the disease had attacked the trees, and making report thereon. This work was continued throughout the fall and closed in the early part of December, with the coming of freezing weather. The plan adopted was to take a rough preliminary draft of each tract upon the ground. The approximately correct location of every chestnut tree on the premises was indicated on the draft and designated by numbers corresponding to a number upon a small wooden tag attached to the tree. At the same time a careful examination of the tree was made and a report noted in record books carried for the purpose, of the condition of the trees, showing the presence or absence of the infection, and in what portion of the tree it existed most prominently. The rough draft finished, it was returned to headquarters, re-drafted with care and accuracy upon tracing cloth, and blue prints made therefrom. A print together with a detailed report on the condition of the trees was then sent to each property owner. This gave him an accurate key to the situation, and it remained for him to decide what to do with respect to treatment, cutting the trees, or whatever else might seem to be called for. In this way nearly 300 properties were examined and reported upon, ranging in size from small town lots to areas of hundreds of acres. Over 30,000 tree groups, representing over 50,000 tree stems, were examined, reported upon, and recommendations relating thereto made to the owners. To prove that The Main Line Citizens' Association was really in earnest, it should be stated that they collected and expended for this work nearly $3,000, and the cooperation of the Department of Forestry represented an expenditure in time nearly equal in value to the expense of the committee.

The committee having this work in charge and representing the association consisted of the following gentlemen, property owners and residents in the immediate neighborhood: Harold Peirce, of the New York Life Insurance Co., chairman; Allen Evans, architect; Theodore N. Ely, superintendent of motive power of the Pennsylvania Railroad; Edgar

C. Felton, president of the Pennsylvania Steel Co.; Wm. Righter Fisher, attorney at law, of the Philadelphia bar; Alba B. Johnson, vice-president, Baldwin Locomotive Works; Robert W. Lesley, president of the American Cement Co.

When the work of inspection had proceeded, it was seen that the infection was of great extent, averaging more than fifty per cent. of all the trees examined. Under these conditions individual and unsystematic effort would and probably could avail but little against the progress of the infection. It was decided that the aid of the government should be called in to render the necessary assistance. The Department of Forestry of the state of Pennsylvania was without direct legislative authorization to do work of this character on a state-wide scale, and without appropriation if it had the authority. The national government was appealed to and word came back that the appropriation bills were all drawn, had passed the house of representatives and were on their passage through the senate, with little or no prospect of change or increase in appropriation. However, the active interest of Senator Penrose was enlisted, and an amendment was added by him in the senate to the agricultural appropriation bill, carrying $5,000 for the purpose of further study and investigation of this tree disease; and in the very last hours of the session, which ended March 4, 1911, the amendment was agreed to by both houses and shortly thereafter became a law by the signature of the president. Thus, it will be seen that through the activities of the committee representing the above association there was accomplished what at first seemed almost hopeless. With this success in mind, the committee and their friends and Pennsylvania state officials familiar with the situation turned to the legislature, then in session, for help and legislative authority to attack the problem in Pennsylvania. The governor of the commonwealth sent an urgent message to both houses of the legislature, a bill was introduced simultaneously in both, was passed without debate or a negative vote, and became a law by the signature of the governor, June 14, 1911. The same phenomenal good fortune attended this effort, and the law itself is looked upon as marking a great epoch in work of this kind. It provides for the creation of a commission of five persons, confers complete authority to attack and destroy this disease by whatever method they may adopt, and appropriates $275,000 for two years for the purpose of carrying on this work. The commission, only recently appointed by the governor, consists of the following persons: Samuel T. Bodine, Villa Nova, vice-president and general manager of the United Gas Improvement Co.; George F. Craig, Rosemont, wholesale lumber dealer and large lumber operator; Theodore N. Ely, Bryn Mawr, former superintendent motive power, Pennsylvania Railroad Co.; Harold Peirce, Haverford, of the New York Life Insurance Co.; Winthrop Sargent, Bryn Mawr, former president Standard Supply and Equipment Co.

The commission has effected an organization by choosing Mr. Sargent chairman, Mr. Peirce secretary, and Mr. Samuel B. Detwiler, a Minnesota forester, but a Pennsylvanian by birth, executive officer to have full charge of the work. Permanent offices have been secured in the Morris Building, Philadelphia.

In order that valuable time might not be lost while the organization was being perfected, the Department of Forestry of the state organized the outside work by sending men first to an instruction camp and then starting them out as scouts in lower York County, to locate infection and report on its prevalence.

Reports from these parties are now being received daily. With additional parties organized, York County will soon be covered and the work will then continue up the west side of the Susquehanna River and westward along the Maryland line. A large amount of preliminary work will be done this year in the hope that the winter work of taking down infected trees may accomplish the desired end, preventing further westward spread of the infection.

I. C. Williams,
Deputy Commissioner of Forestry of the State of Pennsylvania

THE SCHOOL OF AMERICAN ARCHEOLOGY

THE School of American Archeology, organized in 1907 under the act of incorporation of the Archeological Institute of America, held during the month of August a summer session in the Palace of the Governors at Santa Fé, the headquarters of the School, and at the Excavation Camp in El Rito de los Frijoles, where the school has conducted excavations for the past three summers.

The work consisted of examination and study of the communal house, cliff dwellings and the ceremonial cave of this deserted Pueblo, excavated in former seasons, and of lecture courses intended to give to regular students and auditors a view of the general field of archeology.

Director Hewett gave a series of peripatetic lectures on the excavations already made and in progress and on the culture of the Pajaritan plateau as revealed by them; Mr. Chapman, of the staff of the school, lectured on the development of design in ancient Pueblo pottery, and Mr. Harrington, also of the staff, lectured on the language, social organization, religion and mythology of the Mohave Indians, presenting results of his recent field work in the Colorado basin.

In addition to these courses in American archeology, Professor Frank E. Thompson, of the University of Colorado, gave ten lectures on primitive man and the evolution of culture; Professor Mitchell Carroll, general secretary of the institute, gave a series of lectures on Greek archeology with special reference to the excavations in Greek lands conducted by the institute and school at Athens; and Professor Lewis B. Paton, of Hartford Theological Seminary, lectured on the ancient Semites, discussing the primitive Semitic life, literature, art, religion and social organization.

A series of Sunday-evening lectures was given in the Hall of Representatives in the capitol, as follows: "Jerusalem in the Time of Christ," by Dr. Paton; "The Holy Cities of Ancient America," by Dr. Hewett; "The Early History of Christianity," by President E. McQueen Gray; "Paul at Athens," by Professor Carroll.

The excavations of the present season in the Rito were confined largely to clearing the old elliptical communal dwelling in the valley, the excavation of which was more than half completed last summer. The attendance upon the summer session was very good, about fifty being regularly enrolled.

The managing committee of the School of American Archeology held its annual meeting in connection with the summer session, August 24–26. Alice C. Fletcher, of Washington, D. C., was reelected chairman; the office of vice-chairman was created, and William H. Holmes was elected. Standing committees were appointed on finance, the museum and the scientific and educational work of the school. Director Hewett reported on the excavations conducted during the past year at Quirigua in Guatemala, on the research work of members of the staff and the summer session. Plans were formed for the conduct of the excavations in New Mexico and Central America during the coming year, and for the holding of a second summer session in August, 1912.

APPROPRIATIONS MADE FOR SCIENTIFIC PURPOSES AT THE PORTSMOUTH MEETING OF THE BRITISH ASSOCIATION

Section A—Mathematical and Physical Science

Seismological Observations	£60
Upper Atmosphere	30
Magnetic Observations at Falmouth	25
Establishing a Solar Observatory in Australia	50
Grant to the International Commission on Physical and Chemical Constants	30
Tabulation of Bessel Functions	15

Section B—Chemistry

Study of Hydro-aromatic Substances	20
Dynamic Isomerism	30
Transformation of Aromatic Nitro-amines	10
Electroanalysis	10
Plant Enzymes	30

Section C—Geology

Erratic Blocks	5
Paleozoic Rocks	10

Composition of Charnwood Rocks	2
Igneous and Associated Sedimentary Rocks of Glensaul	15
List of Characteristic Fossils	5
Sutton Bone Bed	15
Benbridge Limestone	20

Section D—Zoology

Index Animalium	75
Table at the Zoological Station at Naples	30
Belmullet Whaling Station	20
Secondary Sexual Characters in Birds	10

Section E—Geography

Equal Area Maps	20
Calculation of Areas on the Spheroid	25

Section G—Engineering

Gaseous Explosions	60

Section H—Anthropology

Glastonbury Lake Village	5
Age of Stone Circles	15
Anthropological Notes and Queries	40
Artificial Islands in Highland Lochs	13
Physical Character of Ancient Egyptians	40
Excavations in Easter Island	15
Anthropometric Investigations in British Isles	5

Section I—Physiology

The Ductless Glands	35
Table at the Zoological Station at Naples	20
Anesthetics	20
Calorimetric Observations	40

Section K—Botany

Structure of Fossil Plants	15
Experimental Study of Heredity	35
Survey of Clare Island	20
Jurassic Flora of Yorkshire	20

Section L—Education

Mental and Physical Factors	5
Overlapping	5
Industrial and Poor Law Schools	10
Influence of School Books on Eyesight	5

Corresponding Societies Committee

For Preparation of Report	25

Special Grant

Collections to Illustrate Natural History, etc., of the Isle of Wight	40
Total	£1,050

SCIENTIFIC NOTES AND NEWS

At the meeting of the corporation of Yale University on September 18, Sir William Osler, regius professor of medicine at Oxford, was appointed Silliman lecturer for 1912, and Dr. Joseph P. Iddings, until 1908 professor of petrology in the University of Chicago, and now engaged in geological research, was appointed lecturer for 1913.

Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, has been awarded the Cameron Prize in practical therapeutics by the University of Edinburgh in recognition of his work in cerebrospinal meningitis. In accordance with custom Dr. Flexner has been invited to deliver an address at the University of Edinburgh during the coming academic year.

The *Journal* of the American Medical Association notes that the tenth volume of the *Archiv für Orthopädie* is dedicated to Gustav Zander on the occasion of his seventy-fifth birthday. The first nine articles describe Zander's work and apparatus for medico-mechanical exercises and the opening of his institute at Stockholm, Sweden, in 1865 and of similar institutions on this model in other countries. The benefits of these mechanico-therapeutic exercises in the various internal infections are emphasized by different authors. From 1880 until recently Zander was docent of medical gymnastics at the University of Stockholm.

The Belgian Academy of Sciences has elected as foreign members Professors Emil Fischer and Simon Schwendener, of Berlin, and Professor J. Pawlaw, of St. Petersburg.

As a memorial to Noah Porter, formerly president and professor of philosophy at Yale University, it is proposed to erect a gate at the south end of University Avenue at a cost of $18,000.

Dr. Jacques Hadamard, professor of analytical and higher mechanics in the University of Paris, will give at Columbia University during the month of October courses on the calculus of variation and partial differ-

ential equations of physics. In addition he will give four general lectures on Saturday mornings at 10.30 A.M., as follows:

October 7—"The Definition of Solutions of Linear Partial Differential Equations by Boundary Conditions. How is the Problem to be Set?"

October 14—"On the Recent Applications of certain Mathematical Theories to Physical Problems: Ordinary Differential Equations, Integral Equations, Integro-differential Equations, etc."

October 21—"Analysis Situs, its Rôle in several Mathematical Questions, especially in Finite Correspondences and Differential Equations."

October 28—"Elementary Solutions of Partial Differential Equations and Green's Functions, with Especial Attention to the Latter."

PROFESSOR O. P. HOOD, head of the department of mechanical and electrical engineering at the Michigan College of Mines, has been appointed chief mechanical engineer of the Bureau of Mines with headquarters at Pittsburgh, Pa.

DR. DANIEL W. FETTEROLF has resigned as demonstrator of chemistry and toxicology in the University of Pennsylvania, to accept the position of acting assistant surgeon in the U. S. Army, with a permanent station in New York.

PROFESSOR FREDERICK STARR, of the University of Chicago, whose anthropological studies have covered Mexico, Japan and the Kongo, sailed from Seattle in August for Korea, where he will spend the next few months.

MR. GEORGE GARNERHAS arrived in this country from the French Congo, bringing with him for the New York Zoological Park a female gorilla, about eighteen months old. It is said to be the second gorilla which has reached this country alive.

SIR CLEMENTS R. MARKHAM has been selected president of the eighteenth International Congress of Americanists, to be held in London beginning on May 27, 1912. Applications of membership in the congress and titles of papers should be sent to the secretary, F. C. A. Sarg, Esq., Royal Anthropological Institute, Great Russell St., London.

THE British Association for the Advancement of Science at its Portsmouth meeting, constituted a new section devoted to agricultural science, to be known as Section M.

THE thirty-second meeting of the Society for the Promotion of Agricultural Science, will be held at Columbus, Ohio, on Tuesday, November 14, 1911, immediately preceding the convention of the Association of American Agricultural Colleges and Experiment Stations. Headquarters will be at the Great Southern Hotel, where the sessions will probably be held.

A CALL has been issued by President Seth Low of the National Civic Federation for a meeting of the new Pure Food and Drug Department of the federation, which will be held in the rooms of the New York Board of Trade and Transportation on Monday, October 2. Among the speakers will be Dr. Harvey W. Wiley, chief of the Bureau of Chemistry; Dr. Thomas Darlington, ex-Commissioner of Health for the city of New York, and Dr. William C. Woodward, secretary of the American Public Health Association.

FOREIGN journals state that a special commission was recently appointed to study the utilization of aeroplanes for ensuring rapid communication with districts of the Belgian Congo that are still unprovided with railways and roads, and that it has been decided to await the results of certain tests to be carried out in France. Attempts will be made to traverse a desert about 750 miles across, and to establish landing stations 250 miles apart, fitted with wireless telegraphy. The aeroplanes will have to convey three passengers and a relatively heavy load of victuals, water, tools, etc. It is hoped that this line will be established in 1912. A first subsidy of $80,000 has been voted for the establishment of these communications.

A COMMITTEE dealing with the hygienic aspects of illumination has been appointed by the minister of the interior in France. The objects of the committee include the general effects of illumination on health, the framing of simple rules as to the best means of applying customary systems of lighting to various industrial operations, the nature and causes of

short sight and impairment of vision, and their connection with defective living conditions, the study of methods of measuring illumination, etc.

We take from the *Geographical Magazine* some details in regard to the Antarctic expedition of Dr. Douglas Mawson, who left London for Australia in June and is now completing the arrangements for the final departure of his expedition from Hobart before the close of the year. As promised to Dr. Mawson before he left England, a treasury grant of £2,000 towards the expenses of the expedition has been provided for; the Australian Commonwealth Government has made a grant of £5,000. His ship, the *Aurora,* which was built at Dundee in 1876, arrived in the Thames from Newfoundland in June, and was placed under the command of Captain J. K. Davis. After undergoing extensive alterations, she sailed from the West India Docks on July 27, was "swung" for the adjustment of her compasses under the direction of the Admiralty officials at Sheerness, and then proceeded to Cardiff to take on board supplies of coal, finally leaving these shores on August 4, bound for Cape Town and Hobart. She is a roomy vessel of her class, a little smaller than the *Terra Nova,* her dimensions being—length over all, 165 feet; breadth, 30 feet; depth, 18 feet; gross register, 580 tons. She is fitted with a compound engine of 98 nominal horse power, and is capable of a speed of 9 knots an hour. A new multitubular boiler was put into her in 1905, and under steam she consumes 11 tons of coal a day. For sailing purposes in the Antarctic seas, her rig has been altered from that of a schooner to that of a barquentine. The accommodation aft has been remodeled, so as to serve the requirements of the large scientific staff she will carry from Hobart to the shores of the Antarctic continent. Other alterations include the erection on deck of a biological and a general laboratory. Most of the staff will join in Australia, the only members sailing from England in the *Aurora*—besides the ship's officers—being Dr. Mertz, a Swiss zoologist, who is an experienced mountaineer, and who won the Swiss ski-jump championship in 1908; and Lieutenant Ninnis, Royal Fusiliers, who will take part in the survey work. At the request of the Prince of Monaco, who has provided the expedition with its oceanographical equipment, Dr. Mertz went through a special course of training at the Monaco Oceanographical Laboratory and on board the *Princesse Alice.* A valuable equipment for magnetic work has been lent by the Carnegie Institution of Washington. The *Aurora* carried, when she left England, forty-eight Greenland dogs, obtained through the kindness of the Danish Government, and a large number of Norwegian-built sledges, as well as the bulk of the stores and food supplies for the three parties which it is hoped to land between Cape Adare and the Gaussberg.

According to the London *Times* a departmental committee consisting of Mr. Angus Sutherland, C.B., chairman, Mr. J. E. Sutherland, M.P., Mr. H. M. Conacher, Dr. T. Wemyss Fulton and Mr. J. Moffatt, has been appointed by the Secretary for Scotland to inquire into and report upon the character and national importance of the inshore and deep-sea fisheries of Norway and other countries engaged in the North Sea fisheries, and the efforts made for the development of the fishing and fish-curing industry in all its branches, including (1) the systems of fishery administration, including the constitution and function of the local committees formed for this purpose in Norway and of any similar organizations in the other countries; (2) the facilities provided for research and for educating and training those engaged in these industries, by the establishment of technical schools, museums, laboratories, classes or other special facilities; (3) the nature of the various means of capture employed and the methods (including any use of state credit) by which fishermen obtain the necessary capital to maintain the efficiency of their vessels and equipment; and to report in regard to each of the foregoing matters whether it would be advisable for similar action to be taken, with or without modifications, in the

case of the Scottish fishing industry, and, if so, what means should be adopted.

UNIVERSITY AND EDUCATIONAL NEWS

AT the University of Pennsylvania Dr. R. M. Pearce has withdrawn from the chair of pathology and will confine his work to the chair of research medicine, and Dr. Allen J. Smith returns to the charge of the department of pathology, retaining at the same time the directorship of the laboratories of comparative pathology and tropical medicine.

DR. J. H. CLO, of the University of Chicago, has been appointed to the chair of physics in Tulane University.

DR. HOWARD T. KARSNER, demonstrator of pathology in the University of Pennsylvania, has been appointed assistant professor of experimental pathology in Harvard University.

AT the University of Maine, Dr. M. A. Chrysler, professor of botany, has been appointed head of the department of biology to succeed Dr. G. A. Drew, and Mr. H. M. Parshley has been appointed instructor in zoology.

DR. FRASER HARRIS, at present lecturer on physiology in the University of Birmingham, has been appointed professor of physiology in the Dalhousie University, Halifax, Nova Scotia.

THE appointment of lecturer and demonstrator in the physical department of the East London College, vacant by the resignation of Mr. E. Marsden, M.Sc., on his election to the John Harling Research Fellowship at the University of Manchester, has been accepted by Mr. T. Harris, B.Sc., of the Imperial College of Science and the Cavendish Laboratory, Cambridge. Mr. Harris has been engaged in advanced research work under Professor Sir J. J. Thomson.

DISCUSSION AND CORRESPONDENCE

"WASHINGTON SCIENCE"

THE phrase which heads this communication appears now and then in print and may be assumed to have a depreciatory significance, whether this is due to a mistaken estimate of the quality of research work done in that city under governmental supervision; or with a feeling that scientific men so employed have what in college slang is termed a "soft snap"; or to a vague impression that a man willing to accept government employment must necessarily be a lower order of being in his general class, or to all these ideas combined in varying proportions—can not be decided here. But it occurs to me that the experience of one who has spent nearly half a century in scientific work, under government auspices, might throw some needed light on the subject for those without similar experience.

It is to be premised that scientific men differ like other men in their temperaments, breadth of view and social training. Their interest in and devotion to a particular line of research does not divest them of the common frailties of mankind, whether in Washington or elsewhere. In the history of American science, the three least creditable and most bitter controversies which have affected the relations of scientific men were between scientists of a high order, not Washingtonians.

Civil service reform has changed for the better in many ways the conditions confronting those desiring to enter the service of the government. Yet the writer entered that service at a time when no such reform had been instituted, and from the first day to this date has never been asked what his politics were or requested to secure "influence" to maintain his position or obtain promotion. The fact that he was believed to possess certain qualifications for his work and has conducted it since appointment in a satisfactory manner has covered the whole ground.

So far as the writer knows, barring the changes due to civil service reform laws, this experience is not exceptional.

We hear much about "red tape" as an obstacle to efficient work. Now "red tape" means fundamentally the fixing of responsibility. This may be either financial or other. The uninformed critic does not realize that the function of "red tape" is reciprocal, that

it not merely protects the government, but the individual whose service is governed by it, and whose devotion to a special object might in many cases without such wholesome restraint lead him to forget that he must keep step with his colleagues. Furthermore, "red tape" is not merely a governmental device, but is universal in all large organizations, private or public, and so far as the writer's observations extend, is, if anything, more rigid in private practise. No college, corporation or organized service is without it, and the occasional abuse of its restrictions is as common in these bodies as in the government service.

The features of "red tape" which are occasionally injuriously restrictive in government work are almost invariably due to the well meant but hasty desire of some "reformer" in congress who has discovered some supposed laxity in the public service and, desiring to make it impossible for the laxity to continue, procures the enactment (always easy) of some iron-clad restriction upon the action of public servants. After congress has adjourned the executive legal officers find that the language of the act is so broad that it covers proceedings never intended to be affected and entirely foreign to the supposed abuse it was intended to correct. Fortunately such blunders are less common than of old. "Pure ignorance, ma'am," as Dr. Johnson said, and certainly not to be charged to the account of science, Washington or other.

There is a very large class of employees in government service, in the wide sense, who are merely clerks and who are very much like clerks outside of the service, except that they have to live in a city where their easy hours and generous vacation hardly make up for its humid heat and excessive cost of living.

The great majority of these clerks do a fair day's work, but there were in past years enough of the element owing their position to "influence," and therefore more or less independent of their superiors in office, to give the service a bad name, which will probably endure a long time after such conditions have become merely a memory.

In the scientific corps if I may term it so, we have a body of men who for the most part seek and keep their positions for the wide opportunity for research the government work offers.

Few of them would be able to remain if they had not some private income additional to their inadequate salaries. The pay averages about that of the second-rate colleges, without the opportunity for economy and plain living without loss of social standing, which most colleges afford.

The cost of living in Washington has considerably more than doubled since the writer's residence began. When to decent clothing, food and shelter required by one's surroundings are added the care and education of a family, the subscriptions to a few periodicals and societies absolutely necessary to a scientific man, it is certainly not without personal sacrifice that the majority of the corps stand their ground.

Nor among the leaders is there cause for criticism in the matter of their devotion to science. Time and again have men fallen by the wayside, victims of voluntary overwork and nervous strain, which took no note of official hours or vacations. Every Washingtonian man of science knows of such men and honors their memory.

As to the quality of work turned out, it speaks for itself and is in no need of eulogy.

It is true that certain bureaus have fallen into evil times, for which we have to thank chiefly the late Mr. Cleveland's scorn of scientific men. One of them has become little more than a pasture for politicians, but nearly all its scientific workers have deserted it and its publications of a scientific character in the main are the work of men outside the service.

In this, as in less notorious cases, the just criticism that may be made should have for its basis not Washington science or Washington scientific men, but the ignorance of legislators and the indifference of politicians and the public.

The men of science, not of Washington,

have more or less responsibility resting upon them for whatever may be properly criticized in the governmental scientific corps. Efforts the corps itself may make for betterment are liable to the charge of self interest. The "outsiders" can help, if they will, to promote the ideal service. For such help no one will be more grateful than the members of the corps concerned.

A long dissertation illustrative of the statements above made might easily be written, but space requirements forbid it here.

In conclusion the writer is confident that neither in this country nor elsewhere is to be found a body of men of science more devoted to their work, more self-sacrificing in their devotion to it, and with a more honorable record, than the scientific corps of the government service, however, in the human way, it may fall short of the ideal.

WASHINGTONIAN

"BIOLOGY"

TO THE EDITOR OF SCIENCE: The publication in SCIENCE, of September 8, 1911, of a request that you "refuse to print any communication in which the adjective 'due' appears in any way except as agreeing . . . with some noun or pronoun" leads me to refer to the advertisement on page 1, of the same number, which gives, under six heads, a list of educational books for sale, one of the heads, "Biology," listing texts on "Laboratory Zoology," "Mammalian Anatomy" and "Zoology"; another head is "Botany," listing a "Guide to Laboratory and Field Studies," "Plant Anatomy" and "Vegetable Physiology."

After we have decided what the difference is between water-vapor and steam, and why the ether can not be made of electrons, will you please allow space for replies to the following question: What is there more "biological" about laboratory zoology than about laboratory and field studies in botany, about mammalian anatomy than about plant anatomy, or about a text-book on zoology than one on vegetable physiology?

Will not SCIENCE hereafter please refuse to publish any communication or advertisement in which the word biology is used as synonymous with zoology? Zoological journals please copy!

C. STUART GAGER

BROOKLYN BOTANIC GARDEN,
September 11, 1911

HOUSE AIR

TO THE EDITOR OF SCIENCE: Before the last echoes of the discussion as to indoor and outdoor air, humidity and so on die away I should like to add a word as to the general neglect on the part of doctors and nurses to look carefully into the nature of the air supply. There is an increasing tendency to prescribe life out of doors, even in bad weather, as almost a specific for many pathological conditions, from incipient tuberculosis to weak heart action. But after all, most sick people are indoors during the greater part of the twenty-four hours, at most seasons of the year. And yet it is rare indeed to find even an exceptionally intelligent physician who knows in detail at what rate the air of the patient's room is being changed, what is its origin, or its relative humidity. Physicians rather commonly and nurses almost always ignore the difference in ventilating effect between furnace or indirect steam heating and hot water or steam pipes in the rooms of the house. I have heard an unusually intelligent nurse, a woman with years of thorough training in her calling, argue for a half hour that no change of air could be accomplished by an open furnace register—she doubted whether any air came into the room from that source at any time.

As a matter of fact the ventilation from a register of ordinary size (say $9\frac{1}{2} \times 15\frac{1}{2}$ inches) in freezing weather, with a reasonable fire in the furnace, is much better than can ever be obtained in summer by opening a single window to its full height. There is no other simple way of securing cold weather ventilation in ordinary houses so certain to act efficiently as heating with a furnace provided with a capacious cold air duct. Still

this source of air supply leaves much to be desired on the score of quality. Much street dust may enter the cold air box and be distributed throughout the house. And few realize the parching quality of the air in furnace heated houses. I have found the air in a house heated by a good furnace in moderately freezing winter weather in Massachusetts with a relative humidity as low as 16 per cent. This, too, was with the water reservoir of the furnace well filled. Such air is far dryer than that of an oasis of the Sahara in the driest season of the year and it irritates the skin and mucous membrane and carries off moisture so rapidly in insensible perspiration as to make it necessary to maintain the room temperature at a point several degrees higher than would otherwise be demanded.

Furnace heating may be made to furnish much better air for breathing by straining the air, either by means of a thin layer of cotton batting at the entrance of the cold air box or by a layer of the silk-like glass fiber, used for jacketing steam pipes and so on, under each register. The humidity may be considerably increased by supplying boiling water to the evaporating reservoir in the furnace. In single rooms it may be raised by keeping a large coarse towel, frequently wrung out, hung from any convenient support immediately over the register. Where there is a combination of steam and furnace heating, the hot air may be moistened to any desired extent by letting a very minute steam jet enter the heated air inside the outer jacket of the furnace.

Whatever the nature of the heating apparatus employed, the householder of inquiring mind will find a good deal of food for reflection in the results obtained by burning touch-paper just over the registers or radiators which serve as the source of heat and watching the distribution of the heated air and by measuring the relative humidity of the air in some living rooms in cold weather, by means of a sling psychrometer. The values corresponding to the readings of the wet bulb and dry bulb thermometer can be obtained by inspection of the "Psychrometrical Tables" published by the U. S. Department of Agriculture, Weather Bureau.

J. Y. Bergen

Cambridge, Mass.

Elementary Text-books in Chemistry

To the Editor of Science: Professor Miller in his address given at Indianapolis and published in No. 870 of Science criticizes in some important particulars the current elementary text-books in chemistry. Personally I would have been better pleased with the excellent and timely address if he had said "many text-books," or "most text-books," instead of "our text-books." It should also be said that an elementary book ought rather to be conservative than radical, as long as the conservative position has a considerable following among leading chemists.

The particular criticisms offered by Professor Miller suggest the general subject and lead me to speak of one or two others, which I confess do not apply to all elementary texts. Passing by criticisms that are often made—as that many books are too learned and heavy in style, that they make too much of chemical theory and do not show respect enough for chemical fact, etc.—I want to say a word concerning the immense field that the usual book presents to the high school student, to be completed in one year. I do not refer to the size of the book but the amount of matter. Some of the smaller books sin worst in this regard, being little more than a synopsis of a good college book. I know how much can be said in favor of a complete view of an important subject of study, and how much about the vital character of any particular suggested omission, but there is one sort of reduction that might easily be secured. This large field has grown of recent years partly by annexing outlying territory that was formerly regarded as belonging to other subjects of study. Many elementary books are written fully in the spirit of a sentence which I quote from a recent address on chemistry: "Physics, geology, engineering, physiology, botany, zoology and

biology are subdivisions of the broader science of chemistry." Should it not be possible to find a core of this work which is essential chemistry and teach that?

The physics people have met the challenge concerning boundaries and disputed territory courageously. It is not long since I heard a university professor begin a lecture on physics somewhat in this way: "Physics is the science of matter and energy. This field is so large that it is customary at present to break off the physics of the molecule and its reactions and call it chemistry. Also to put to one side the physics of the heavenly bodies and call this part astronomy," etc. So these two subjects, physics and chemistry, have been mutually devouring each other, like two Kilkenny cats, lo these many years. It seems to have been good for them, however, for both have grown to be lusty fellows. The only difficulty seems to be to determine which is which. Suppose we give up trying, call the amalgamated science what you like, and frankly make a two-years course in this science, with the topics arranged in logical order, as an elementary book for high schools. This would dispose of the not very important but still much discussed question whether chemistry should come in the eleventh or the twelfth year, as well as the far more important matter of extensive duplication. At first sight it might seem desirable to repeat a large amount of physics in the chemistry classes, especially as this part is in general very important, but a moment's thought will convince any one—not already convinced by experience—that this is not likely to be true. The work presses; the class will meet these subjects elsewhere; nobody is responsible for a full presentation of them; and so the few ideas most essential to further progress are made to suffice. There is no one to apply the excellent homestead law—one must not only stake out a field but occupy and do some work upon it.

If a two-years' unitary course in physical science can not be secured, some competent authority—say a joint committee of the chemical and physical societies of America—might be asked to say what shall be taught as chemistry and what as physics. For instance, where shall the modern doctrine of solutions be taught? How much of combustion, of electrolysis, of the action of a primary battery, is chemistry and how much physics?

E. A. STRONG

SCIENTIFIC BOOKS

Physical Optics. By ROBERT W. WOOD, LL.D., Professor of Experimental Physics in Johns Hopkins University. Second Edition. New York, The Macmillan Company. 1911. Pp. xvi + 705. Price $5.25 net.

To those who are acquainted with the earlier edition of Wood's "Physical Optics" it will be high and just praise of the second edition merely to say that it is vastly superior to the first. The new material added to the former discussion—roughly, fifty per cent.—illustrates the tremendous recent development of physical optics; and the manner in which all this work is described continues to illustrate the extraordinary clarity and precision with which intricate matters may be set forth, in a non-mathematical way, by a man who really and profoundly understands his subject.

Of the various additions and improvements, perhaps the following will serve to characterize the whole:

The first three chapters have not been much altered, although they do contain some new material, such as the work of Galitzin and Wilip on Döppler's principle, Pfund's mercury arc, etc.

A very characteristic addition finds place in the fourth chapter, the one dealing with refraction, where a series of photographs taken with a lens immersed in water—a "fish-eye camera"—has been inserted. These give a concreteness and directness to the treatment of the critical angle which could hardly be obtained in any other manner.

Chapter V., on dispersion, shows few changes, but is enriched by a plate showing Julius's remarkable series of photographs of the "D" lines, under various physical circumstances.

The value of the chapter on diffraction is

enhanced by an exposition of A. B. Porter's work on the nature of optical images, by the author's clever vectorial treatment of secondary maxima in grating spectra, by an account of the Echelette grating, and by a new viewpoint from which to regard Talbot's fringes —all of which have recently appeared in the *Philosophical Magazine*. The discussions of interference and polarization remain almost intact. A brief but entirely new chapter is here given to "Meteorological Optics."

The beautiful method of focal isolation by which Rubens and Wood have recently been enabled to measure heat waves which are more than one tenth of a millimeter in length, has been inserted in the chapter on the theory of dispersion. But this well illustrates the impossibility of keeping a treatise up to date; for notwithstanding the preface is dated May, 1911, the infra-red spectrum has since then been extended more than an octave and a half; so that now the gap between the electrical and optical spectra is something less than three octaves—the difference between a third of a millimeter and two millimeters.

Interesting additions, dealing with the absorption of gases, have been made to Chapter XV., including Wood's extension of Balmer's series for sodium vapor absorption lines to the 48th member.

The discussion of magneto-optics has been greatly and properly enlarged, and is followed by an entirely new chapter on electro-optics.

Chapter XX., dealing with fluorescence and related phenomena, has a long title of nine words which, in the opinion of your reviewer, might well be replaced with the single term "Photo-luminescence." The Laws of Radiation (Ch. 21) have been made to include the recent achievement of Lebedew in demonstrating experimentally that a beam of light exerts a definite pressure upon an absorbing gas.

The remainder of the volume differs little from the former edition except that a final chapter on the principle of relativity has been added. But to attempt an elementary exposition of the ideas of Einstein and Minkowski in twelve small pages is well nigh attempting the impossible. Lack of consecutiveness makes this last chapter the only unsatisfactory one in the entire volume.

Of the book as a whole it ought to be remarked that it teems with practical hints of great value, clever bits of experimental experience from the large fund for which the professor of experimental physics in Johns Hopkins University is justly celebrated. The policy of the author in maintaining a quantitative discussion throughout, and yet refraining from the use of very advanced or severe or complicated mathematical methods, is to be highly commended. It is a matter of constant surprise to find what a large proportion of all really important phenomena can be described by very simple differential equations and can be discussed by the ordinary analysis. This remark is, of course, only intended to apply to the mathematical method of a treatise for students of physics, and not to an original paper describing the results of a mathematical investigation.

A work so altogether admirable as this should not be marred by so many typographical errors and incomplete references. Sometimes one is referred merely to "*Phil. Mag.*," at other times, as for instance in Runge's exquisite treatment of the concave grating, p. 233, one is merely told that the discussion is "due to Runge." Economy of energy on the part of the reader will be greatly served by the correction of many of these slight matters in a future revision.

However views may diverge as regards the treatment of various topics in this volume, there can surely be no difference of opinion among English-speaking students as regards the generosity which Professor Wood has shown in taking time and energy from a strenuous life of research to prepare this clear, scholarly and thoroughly modern treatise. Appreciation of this can hardly fail to show itself in a long and wide-spread use of the book.

Henry Crew

Atlas of Zoogeography. By J. G. Bartholomew, W. Eagle Clark and Percy H. Grimshaw. Series title: *Bartholomew's Physical*

Atlas. Volume V. 46.5 cm. Published under the patronage of the Royal Geographical Society, Edinburgh. 1911.

This handsome folio contains a limited text and "a series of maps illustrating the distribution of over seven hundred families, genera and species of existing animals." The text is divided as follows: I., General Principles of Distribution (2½ pp.); II., Historical and Geographical (8½ pp.); III., Zoological (44 pp.); and Bibliography (11 pp.). The 36 double-page plates following are mostly divided to include six world maps each, thus making about 200 maps in all. "All the families of mammals, birds, reptiles and amphibians, together with several of the more important genera and species, have been dealt with, while the work embraces in addition most of the families of fishes and a selection of families and genera of molluscs and insects." Two plates show the zoogeographical regions according to various authors, while another indicates diagrammatically the vertical and latitudinal distribution of life and inset maps illustrate prevailing vegetation, ocean currents and bathy-orographical configuration.

As a contribution to the subject of zoogeography, the work makes no serious pretensions, being strictly a compilation from existing published data, and as such is to be judged like a geography or a dictionary. In scope and finish, it surpasses anything previously attempted and will doubtless fill in large measure the place which has long been waiting for such a work, both in special and in general libraries. The great advances in knowledge of the distribution of life made in recent decades render a graphic accounting of this sort particularly welcome. The difficulties of fully attaining the desired object, however, are very great. Many groups, even of the higher vertebrates, have not been thoroughly studied from the distributional standpoint and only in few instances are the data to be found collated for use. Instead they are widely scattered, often extending into the literature of several tongues and variously concealed among irrelevant matter. On this account, perhaps one should not assume too critical an attitude toward the detailed results of a necessarily involved task subject to the limitations of time and generalized authorship. To be beyond particular criticism, such a comprehensive work could be produced only by the combined effort of a number of specialists.

One may readily understand and excuse omissions in a work of this nature, but gratuitous extensions of distribution can not be passed so lightly, for misgivings arise as to the methods pursued. The authority, for example, which led to the extension of the range of the jaguar over the whole peninsula of Lower California must have been one which stated things in very general terms. The same may be said of carrying the distinctive color for the raccoon up the coast of British Columbia and Alaska to the base of the Alaska peninsula—a matter of over 1,000 miles of distribution without basis in fact. That this is not a mere slip is indicated by a statement of the same error in the text. The sewellels (*Aplodontia*) are given a range from Puget Sound to San Diego and the pocket gophers (Geomyidæ) cover Vancouver Island and the coast of British Columbia north to the southern boundary of Alaska, considerable deviations from the real conditions. Although the reviewer has given more hasty and less competent scrutiny to the maps of groups other than the Mammalia, there are indications that no greater degree of accuracy obtains among them. One instance may be cited in the Insecta in the ranges of the well-known genera of mosquitoes, *Anopheles* and *Stegomyia*. The former is carried north to Hudson Bay and the latter to central Wisconsin, both somewhat beyond the limits known. In view of these shortcomings and others which might be mentioned, it is evident the maps can not be trusted for finer points of distribution; but they are so well executed and so useful in their general bearings that one almost feels tempted to withhold detailed criticism.

The text is brief but somewhat more than a mere explanation of the maps. In discussing the general subject, it is interesting to note that although they adopt the classic divisions of Wallace and accord first and most promi-

nent place to his map, the authors have not been able to avoid various parenthetical and semi-apologetic references to the "holarctic." The divisions of Sclater, made in 1857, are introduced as the beginnings of zoogeography and no mention is made of the much earlier work of Wagner in 1844[1] nor of the map published by Agassiz in 1854.[2] The groups illustrated by the maps are taken up in systematic order in the zoological text, the number of species in each is stated, peculiarities of distribution are mentioned, and brief statements are given of the character and habits of the animals. In addition, the number of fossil forms in each is stated. The distribution of fossil forms is not illustrated and only the present range is shown of animals that have become restricted during historic times. The bibliography is conveniently classified according to regions and groups and is rather extensive, although necessarily consisting of selected titles, since the number of publications having some pertinence is almost unlimited. Certain important papers are omitted, however, and many rather inconsequential ones have a place. Under Neotropical Region, one notes with some surprise the absence of any reference to such important works as Azara's "Paraguay," Tschudi's "Fauna Peruana," Maximilian's "Naturgeschichte," Castelnau's "Expedition," and Darwin and Waterhouse's "Zoology of the Voyage of the Beagle."

As a book, the atlas is very pleasing. The binding, paper, typography and arrangement are excellent. All the maps are mounted on linen-hinged tabs and the colors employed in limiting the distribution areas are soft and harmonious. That it will have a large sphere of usefulness is unquestionable and in spite of what must be said as to looseness of detail, a large measure of gratitude is due the authors for having performed the prodigious labor involved and produced a work on such excellent general lines.

Wilfred H. Osgood
Field Museum of Natural History

[1] "Die Geographische Verbreitung der Saugethiere."

[2] In Nott and Gliddon's "Types of Mankind."

Der Aufbau der Skeletteile in den freien Gliedmassen der Wirbeltiere. Untersuchungen an urodelen Amphibien. By H. von Eggeling, a. o. Professor und Prosektor anatom. Anstalt Universität Jena. Gustav Fischer. 1911. Pp. 324, with 4 lithographic plates; 147 figures in the text.

The author states in the preface that he was led to undertake a broad study of the comparative anatomy and histogenesis of the skeleton and ligaments because of the unsatisfactory literature on this subject which he was able to find when beginning a course of lectures at Jena. The present volume represents the first stage of this study and contains an extensive account of the skeletal structure of the limbs of urodeles. The three questions of general bearing which the author set for himself on taking up the study were as follows:

1. "In what relation to one another stand the so-called coarse-fibrous and fine-fibrous bony substances, the 'Wurzelstock' of Gegenbaur, the cement of the teeth and Sharpey's fibers? What part do these structures take in the structure of bone, aside from a merely topographical one?"

2. "What is the phylogenetic development of the compact bony substance of long bones? How have the Haversian canals arisen, to what extent does their ontogenetic development reproduce their phylogenesis? Are biological conditions to be made out on which the development of vascular canals appears dependable?"

3. "What appears to be the phylogenetic development of enchondral ossification? In what form and under what conditions arise the marrow cavity and the bone-marrow? Where, in what form, and under what conditions do the centers of ossification of the epiphyses develop? Is there an explanation for the late, purely enchondral, ossification of the carpus and tarsus of mammals?"

The author gives a good review of the literature dealing with the questions which he postulates, then gives an account of the structure of the limb skeleton in the amphibians which he himself has studied, some twenty-

five different species belonging to the phanerobranchiata, the cryptobranchiata, the lechriodonta and the mecodonta. He comes to the following conclusions in answer to the three questions postulated:

1. Osseous tissue is divisible into two distinct classes, coarse-fibrous and fine-fibrous. Coarse-fibrous bone is the more primitive of the two. It is formed beneath the periosteum from which at first it is not sharply separated, and in ontogenetically and phylogenetically primitive conditions the coarse fiber-bundles are usually interwoven in an irregular manner. In highly developed bone the fiber-bundles are more regularly arranged. Some fine-fibrous bone is usually interspersed among the coarse fiber-bundles. Sharpey's fibers are those bundles of coarse-fibrous bony substance which extend inwards perpendicular to the periosteum. The cement substance of the teeth and the substance of the basal plates in placoid organs of selachians are to be classed with coarse-fibrous bone. Fine-fibrous bone is laid down about the loose connective tissue which accompanies the blood vessels which are enclosed in the sub-periosteal bone or which penetrate the endochondrium. It is laid down in concentric layers about the spaces in which the blood vessels lie. No coarse fiber-bundles are ever interspersed among these concentric layers. The dentine of placoid organs and of the teeth is of a nature similar to fine-fibrous bone.

2. Compact bone is composed mainly of fine-fibrous bone and is a far higher type of bone than the primitive coarse-fibrous bone. The vascular canals in bone appeared at first as the chance accompaniment of the periosteal development of bone. They proved useful for the nutrition of the bone. Their importance became increased when fine-fibrous bone was laid down in concentric layers about their walls and when blood-corpuscle-forming bone-marrow was developed from the loose connective tissue accompanying the blood vessels.

3. Enchondral ossification represents the spread of the vascular canals from periosteal bone into axial cartilage. Marrow cavities arose through the anastomosis of branched vascular canals and were present even in the extinct ancestors of the present amphibians. The marrow cavity first appeared in the shaft, then extended into the epiphyses. The development in the epiphyses of special marrow cavities by the ingrowth of blood vessels from the surrounding periosteum represents a relatively advanced stage of development. The elements of the carpus and tarsus phylogenetically long remain cartilaginous. In some of the lower forms there is a slight periosteal ossification of these bones, but this is never extensive and is not found at all in the highest vertebrates in which the ossification of these bones is purely enchondral.

From this study of the development of the skeleton of the limbs in urodeles the author is inclined to take the view that the phanerobranchiates, the cryptobranchiates and siredon are derived from the caducibranchiates. The caducibranchiates, he thinks, are divisible into two groups, of which one, including the desmognathinæ and the plethodontinæ are distinguished from the second group, the salamandrinæ and amblystoma opacum, by a lesser development of marrow cavities, the simple structure of the carpal and tarsal bones, and the almost complete absence of fat cells in the bone marrow.

The monograph, as a whole, represents a careful and satisfactory study of the subject.

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SCIENTIFIC JOURNALS AND ARTICLES

THE twenty-second volume of the *Journal of Morphology* is a memorial volume in honor of Charles Otis Whitman. The third part, issued on September 20, contains the following articles:

"Some Problems of Cœlenterate Ontogeny," Charles W. Hargitt.

"Physiological Animal Geography," Victor E. Shelford.

"On the Olfactory Organs and the Sense of Smell in Birds," R. M. Strong.

"On the Regular Seasonal Changes in the Relative Weight of the Central Nervous System of the Leopard Frog," Henry H. Donaldson.

"The Physiology of Cell-division. IV., The Action of Salt Solutions followed by Hypertonic Sea-water on Unfertilized Sea-urchin Eggs and the Rôle of Membranes in Mitosis," Ralph S. Lillie.

"The Spermatogenesis of an Hemipteron, Euschistus," Thos. H. Montgomery, Jr.

"The Life History of the *Scolex polymorphus* of the Woods Hole Region," Winterton C. Curtis.

SPECIAL ARTICLES

ON SOME CONDITIONS OF TISSUE GROWTH, ESPECIALLY IN CULTURE MEDIA

In a paper on the regeneration of epithelium published almost fourteen years ago[1] I analyzed some of the internal and external factors in the growth of mammalian tissues and demonstrated the existence of stereotropism in regenerating epithelial cells. I also cited certain statements of other observers which suggested to me the existence of a stereotropic sensitiveness in other varieties of growing vertebrate tissues.

At that time I furthermore had the opportunity to observe that epithelium might grow and show its stereotropic reaction without relation to the underlying tissue, growing merely in contact with blood coagula. This observation suggested to me the possibility of cultivating tissues of vertebrates in culture media *in vivo* as well as *in vitro,* in a similar manner as bacteria had been cultivated. My previous observations on the importance of the contact with solid substances in tissue growth induced me to use solid coagula as the culture medium.[2] I published a communication concerning these first experiments (which had been carried out in Baltimore).[3] In further experiments accidental conditions made it necessary to study the growth of mammalian tissues in culture media with the animal body acting as an incubator. The results of these experiments have been published in detail.[4] To our knowledge in these earlier experiments, for the first time the attempt was recorded in the literature to grow tissues of higher animals under artificial conditions, to separate through culture media experimentally growing epithelial from connective tissue cells and furthermore to study the influence of the addition of certain chemicals upon the growth of tissues.[5]

Demands of other investigations prevented me from extending these experiments into various directions, as I had planned to do for a considerable number of years. Only recently I resumed these studies and I analyzed further the growth of tissues in solid coagula, especially differentiating between the reactions of stroma and parenchyma in tissue growth in culture media. Here I will add the results of some further studies which were made in conjunction with my collaborator, Dr. Moyer S. Fleisher, and a more detailed account of which will appear elsewhere.

1. We investigated to what extent oxygen is necessary for the growth of mammalian tissues in culture media, a problem which had interested me from the beginning of my experiments. In the case of certain higher plants it has been recently shown that a limited anaerobic growth is possible. We used various methods of anaerobic culture methods and we also studied the effect of a diminution in the supply of oxygen. Our results show that growth ceases if oxygen is lacking or noticeably diminished. This applies to various tissues. A noteworthy difference in the reaction of various tissues to lack of oxygen we could not observe. Under these conditions tissues not only cease to grow, but they die. It is much more difficult to determine the effect of an increase in the tension of oxygen on tissue growth. Our experiments, however, make it very probable that in certain cases the life and growth of tissues is favorably influenced if pure oxygen takes the place of air surrounding the culture media.

2. We studied the effect of the combined growth of an oidium-like organism[6] and of

[1] "Ueber Regeneration des Epithels" (chapter 13), *Archiv f. Entw'mech.*, Bd. VI., 1898.

[2] I referred to this circumstance again in a communication to the Society of Experimental Biology and Medicine, Proceedings of the 44th meeting, May 17, 1911.

[3] Chicago, 1907.

[4] *Archiv f. Entw'mech.*, Bd. XIII., 1902; *Journ. Med. Research,* Vol. VIII., 1902; *Journ. Am. Med. Association,* 1901.

[5] *Zeitschrift f. Krebsforschung,* Bd. V., 1907.

[6] This organism was studied in conjunction with Dr. George J. Moore, of St. Louis, and will be described elsewhere.

kidney tissue. This organism had been injected into the circulation of a rabbit and at various periods after the injection pieces of the kidney were transferred into the culture media. In these experiments we found not only that both kidney tissue, stroma and parenchyma, and organism may grow side by side in the culture media, but that under certain conditions the growth of the kidney cells may be quantitatively increased.

It will be of interest to extend these studies to other well-defined microorganisms and to test the effect of their metabolic products and direct action on tissue growth.

3. The stereotropic sensitiveness of connective tissue cells can very well be observed in the process of atresia of the ovarian follicle. At a period when the degeneration of the granulosa has set in, connective tissue cells begin to grow from the surrounding theca into the follicular cavity and to fill it more or less completely. Here we can notice that usually the connective tissue cells do not grow directly into the cavity but move in contact with the wall of the follicle, thus forming a peripheral layer of connective tissue which gradually enlarges as more cells are added.

In certain cases, however, we may observe that connective tissue cells grow directly into the cavity. In these cases it is probable that the viscosity of the follicular fluid is relatively great and that a viscous fluid may permit a direct ingrowth of some tissue cells.

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ON AN INTERPOLATION FORMULA USED IN CALCULATING TEMPERATURE COEFFICIENTS FOR VELOCITY OF VITAL ACTIVITIES, TOGETHER WITH A NOTE ON THE VELOCITY OF NERVE CONDUCTION IN MAN

INQUIRIES, both written and verbal, have come to me asking for information concerning a formula which has been employed in some of my physiological papers on temperature coefficients.

In this communication I wish to answer these inquiries (1) by referring to the antecedents and mathematical significance of the formula as briefly as I may, and (2) by giving one or two examples of its application.

In the first place it must be stated that the formula in question, so far as my work is concerned, is entirely an empirical one. Wherever a series of quantities varies with some exponential factor the formula has been found to be fairly satisfactory for extra- and interpolation. Its origin, as far as I (who am not a mathematician) know, is probably "lost in antiquity." Professor Max Bodenstein, of Hanover, has told me, however, that he thought Berthelot first used it in chemistry. Just lately I find that Bodenstein[1] himself made use of the formula in 1899 for the determination of the temperature coefficient of chemical reaction velocities.

On the other hand, the formula of van't Hoff[2] and Arrhenius,[3] among others, were developed from thermodynamic considerations and therefore have important theoretical foundations.

However, the formula I use,

$$\left(\frac{k_1}{k_0}\right)^{\frac{10}{t_1-t_0}} = Q_{10} \qquad (1)$$

is practically the same, I find, as one of van't Hoff's,[4] namely,

$$\log_{10} k = a + bt. \qquad (2)$$

For if the values of k in (2) for two different temperatures are known, then this equation may be derived:

$$\frac{k_{t+10}}{k_t} = 10^{10 \cdot b}. \qquad (3)$$

Equation (1) is probably more convenient for the calculation of quotients for intervals of 10 degrees (temperature coefficients), but it is also more cumbersome for the calculation

[1] Bodenstein, M., *Zeitschrift für physikalische Chemie*, 1899, Bd. 29, S. 332.

[2] Van't Hoff, "Etudes de dynamique chimique," 1884, p. 115.

[3] Arrhenius, *Zeitschrift für physikalische Chemie*, 1899, Bd. 4, S. 226; "Immunochemie," Leipzig, 1907.

[4] Van't Hoff, *Vorlesungen über theoretische und physikalische Chemie*, 1898, I., S. 224.

of the value of k. This appears from the following:

From equation (1) we have

$$\log_{10} k_1 = \log_{10} k_0 + \left(\frac{t_1 - t_0}{10} \cdot \log_{10} Q_{10}\right),$$

whence

$$k_1 = 10^{\log_{10} k_0 + \left(\frac{t_1 - t_0}{10} \cdot \log_{10} Q_{10}\right)}. \qquad (4)$$

Of course in order to use the simpler equation (2) one must calculate out the values of the constants and these vary, it must be remembered, with the nature of reaction involved.

And now for an example or two to illustrate the application of these formulæ. Barcroft and King[5] studied the effect of temperature upon the dissociation of hemoglobin. In one series of observations an aqueous solution of pure crystals under 10 mm. Hg pressure showed at 14° C. 92 per cent. saturation; at 38°, 24 per cent. saturation. What is the temperature coefficient for intervals of 10 degrees?

This is answered by using either equations (1) or (3). Substituting the observed values in equation (1) we have

$$\left(\frac{92}{24}\right)^{\frac{10}{38-14}} = Q_{10},$$

whence $Q_{10} = 1.75$, the temperature coefficient for intervals of 10 degrees.

From equation (2) or (4) we can now calculate the values of k for the whole of this series of Barcroft and King's observations.

By comparing equations (1) and (3) it will be seen that $Q_{10} = 10^{10 \cdot b}$. Since $Q_{10} = 1.75$, $b = .0243$ and therefore a in equation (2) equals $-.3579$. For the special case under consideration, then, equation (2) reads

$$\log_{10} k = -.3579 + .0243\, t.$$

The table of observed and calculated values of k stands as follows:

Temp. Degrees	k Observed, Per Cent.	k Calculated, Per Cent.
14	92	96
26	56	54
32	38	38
38	24	27

[5] Barcroft and King, *Journal of Physiology*, 1909, Vol. 39, p. 374.

Another and very different example may be taken from the physiology of nerve. As is well known, frog nerve at a temperature of 20° C. conducts the impulse at a rate of about 30 meters per second. It has, furthermore, been shown that the temperature coefficient, or the value of Q_{10} in the above equations, for the conduction time of frog nerve,[6] is about 2.3.

Now if the nature of nerve in both frog and man be essentially the same, the value of Q_{10} is also the same, and from equation (4), which is another expression of (1), we may proceed to calculate the velocity of the nervous impulse in man.

The known values are substituted in (4), taking 37° as the body temperature of man, whence

$$k_1 = 10^{\log_{10} k_0 + \left(\frac{37-20}{10} \cdot \log_{10} 2.3\right)}$$

or $k_1 = 123.6$.

The same result is obtained from equation (2). For since $Q_{10} = 10^{10 \cdot b}$, then $b = .0362$, and for the special case of frog $a = 0.753$, because

$$\log_{10} 30 = a + .0362 \times 20.$$

For the special case of man, then,

$$\log_{10} k = 0.753 + .0362 \times 37,$$

whence $k = 123.6$.

From the above, therefore, we deduce that the velocity of the nervous impulse in man is about 123.6 meters per second. Can this be corroborated by experiment? Happily it can. Professor Piper,[7] of Berlin, has been able to measure the conduction time of the median nerve in man by using the very sensitive and promptly reacting thread galvanometer. From his results he calculates a rate from 117 to 125 meters per second. Using a similar galvanometer, I have been able to confirm this in our laboratory

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[6] Snyder, C. D., Archiv für Anatomie und Physiologie. Physiologische Abteilung, 1907, S. 117; *American Journal of Physiology*, 1908, Vol. 22, p. 309.

[7] Piper, H., *Archiv für die gesammte Physiologie*, 1908, 124, p. 591.